



Transportation Synthesis Report

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Concrete Shoulder Rumble Strips

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Transportation Synthesis Reports are brief summaries of currently available information on topics of interest to WisDOT technical staff. Online and print sources for TSRs include NCHRP and other TRB programs, AASHTO, the research and practices of other transportation agencies, and related academic and industry research. Internet hyperlinks in TSRs are active at the time of publication, but changes on the host server can make them obsolete.

Request for Report

The Bureau of Technical Services requested a synthesis of current practice in the use of concrete shoulder rumble strips. Specific information sought included specifications, detail drawings, and related information on dimensions and locations along shoulders, continuous or intermittent placement design, and information on the preference for forming or grinding in rumble strip construction.

Summary

Shoulder rumble strips (SRS) continue to draw significant research interest around the world, with a particular focus on SRS impact on vehicle operation and maneuvers, driver safety, and road worker safety. Nevertheless, safety research has established since the 1980s the compelling safety value of SRS, and many states have specifications and policies in place for SRS use.

Dimensions and spacing design vary from agency to agency, though synthesis studies show surprising similarity in strip designs between states and even across strip construction methods; whether milled or formed, dimensions and spacing of strips remain fairly similar from state to state. Placement in shoulders varies dramatically, however, from under edgeline paintings to almost three feet from the outer lane edge. While continuous SRS seems favored by practicing agencies, intermittent design has been gaining attention in the last five years both for ease of construction and for providing bicyclists maneuverability on highway shoulders.

Leading states in SRS design and use include Arizona, Michigan, Minnesota and Pennsylvania, and agencies in New York, Connecticut, and Kentucky also show frequently in web-based research. Outside the U.S., Sweden seems to be most active in recent years in studies of safety and design in shoulder rumble strips.

Based on available resources, this study avoids an exhaustive citation of many state design details and specifications, which can easily be prepared in an extensive report upon BTS request, in favor of the most nimble and complete single source for practices around the country: the **FHWA Safety** web site pages devoted to rumble strips. This outstanding site offers excellent syntheses of practices and policies, links to specifications, engineering drawings and policy statements at dozens of state transportation agencies, and links to experts for advice. We highly recommend this site for a quick, easy-to-use, and extremely thorough look at the best practices around the country in the design and use of milled and formed shoulder rumble strips.

We follow with a look at recent research in **Sweden** that is cited in studies and pages across the World Wide Web, and at **Research in Progress and in Publication** so recently as to not yet be available on the Web, but which bear directly on milling and forming strips on concrete shoulders and so warrant attention in coming months.

FHWA Safety: Rumble Strips

The most detailed and useful site on the web for information on practices around the U.S., links to design and policy documents for many states, history of the practice and more. Any survey of national practice would best begin (and possibly end) here. See http://safety.fhwa.dot.gov/roadway_dept/rumble/index.htm. Specific pages are detailed below.

Synthesis of Shoulder Rumble Strip Practices and Policies, March 2001. See

http://safety.fhwa.dot.gov/roadway_dept/rumble/index.htm.

This comprehensive report offers detailed summaries of the state of the practice, and includes design policies and drawings from Arizona and Minnesota, reviews practices and policies around the country, describes results from three surveys, historical information on shoulder rumble strips (SRS), and more. Highlights include:

- In one survey, 39 of 40 agencies responded, showing significant consistency in dimensions of SRS used, including 70 percent of respondents using milled SRS, and 21 of 39 states restricted SRS use according to shoulder width, and 14 also restricting according to bicycle use.
- One survey found 26 states with SRS policies, and 14 with specifications but no policies.
- Two states maintain notably detailed policies. Arizona uses skip patterns and various SRS widths according to roadway types and shoulder widths; Minnesota employs multiple SRS patterns according to roadway type and should widths. Both policies are appended to this FHWA synthesis.
- If not placed continuously, favored patterns include regular skips – for example, 10 meters with and 10 meters without.
- Edgeline offset varies greatly from state to state, with offsets of 5.9 to 23.6 inches typical, but also placement adjacent or partially under edgeline and offset as far as 35.4 in.
- Typical dimensions include:
 - 5.1 in. between strips for milled and rolled;
 - 7.1 in. longitudinal width milled, 1.6 in. rolled;
 - 15.8 in. transverse width milled and rolled;
 - 0.5 in. tire drop milled, 0.3 in. rolled;
 - 0.5 in. depth between strips milled, 1.3 in. rolled.

Policy, Specifications and Drawings. See http://safety.fhwa.dot.gov/roadway_dept/rumble/policy_spec_draw.htm (updated Dec. 2005). Links on specific details for milled rumble strips include specs and drawings from the state agencies in Florida, Kentucky, Michigan, Minnesota, Montana, New York, Pennsylvania, and Wyoming. For formed rumble strips, agencies include those from Arizona, Montana, New York, and South Dakota.

Rumble Strips Library. See

http://safety.fhwa.dot.gov/roadway_dept/rumble/synthesis/pro_res_rumble_library.htm (updated Dec. 2005).

Includes several papers from 1994 through 1999, specifications, drawings, policy statements from various states, video presentations on driver experience, state safety benefits, etc.

Sweden

Placement and Design of Milled Rumble Strips on Centre Line and Shoulder: A Driver Simulator Study. Anna Anund, Magnus Hjalmdahl, et al. VTI Report 523A, 2005. For report in English, see <http://www.vti.se/EPIBrowser/Publikationer/English/R523A.pdf> (120 page document). (For summary, see http://www.vti.se/templates/Report_2797.aspx?reportid=4905.) A 2005 study from a country considered a leader in study and design of rumble strips for center lines and edgelines, investigators focus on driver response, safety and noise levels of various international rumble strip designs. Labeling designs in Sweden and Pennsylvania as “aggressive,” the study includes design data and illustrations throughout, including dimensions and locations. See, for example, Figs. 3, 4 and 5 on pp. 21 and 22, or tables on pp. 31 and 43. See, in particular, appendices (“Annex”) 3, 4, and 6 with specifications, photos, and illustrations for milled rumble strip designs from Pennsylvania, Sweden, and Finland.

Research in Progress or in Publication

Various studies of rumble strips continue. The following pertain to concrete shoulder rumble strip practices.

Completed: Effect of Continuous Shoulder Rumble Strips and Pavement Marking on Lateral Placement of Vehicles. William Taylor, Ghassan Abu-Lebdeh, and Saichin Rai; *Transportation Research Record 1911*, 2005: 105-112. Available in hard copy from the WisDOT Library, this study focused on Michigan tests of near edgeline placement and painting a line on strips to improve retro-reflectivity, as well as driving impacts and pavement

damage. Results show that maintaining the current edgeline while painting a second line on the rumble strips kept drivers away from the pavement edge, reducing noise and potential pavement damage.

In Progress: Guidelines for Using Rumble Strips. A Minnesota study scheduled to finish at the end of May 2006 expects to produce guidelines for standardizing rumble strip using throughout Minnesota, with a focus on suitability in various county settings. See TRB RiP project page at <http://rip.trb.org/browse/dproject.asp?n=8679>.

In Progress: Evaluating the Effectiveness of Continuous Shoulder Rumble Strips in Reducing “Run-Off-Roadway” Single-Vehicle Crashes. This Nevada study, expected to finish in June of 2006, focuses on the effectiveness of various continuous SRS designs. See TRB RiP project page at <http://rip.trb.org/browse/dproject.asp?n=10631>.

In Progress: NCHRP Project 17-32, Guidance for the Design and Application of Shoulder and Centerline Rumble Strips. Expected to be finished in June 2007, this Midwest Research Institute study focuses on optimal design dimensions and placement on divided and undivided highways. See NCHRP project page at <http://www4.trb.org/trb/crp.nsf/All+Projects/NCHRP+17-32>.